SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1623.—Vol. XXXVI. LONDON, SATURDAY, SEPTEMBER 29, 1866. {STAMPED .. SIXPENCE. UNSTAMPED. FIVEPENCE.

SOUTH WALES INSTITUTE OF ENGINEERS.

The ordinary general meeting of members was held on Thursday, Sept. 20, at the Assembly Rooms, Cardiff. There was a numerous attendance, and among those present were Mr. George Martin, the President; Messrs. Brough, Evans, and Wales, Government Inspectors of Mines; W. Menelaus, D. Joseph, A. Bassett, W. Adams, T. F. Brown, J. Cox, R. Bedlington, H. N. Maynard, Alfred C. Jones, H. A. Huzzey, J. T. Wightman, T. G. Robinson, E. W. Richards, P. James, J. James, George Brown, Cope Pearce, Hosgood, E. Brigden, Lee, Jotham, Barber, W. Evans, G. Parfitt, F. Davis, Edwards, H. Martin, Loam, Weeks, D. Davies, Truran, &c.

MODELS, PLANS, AND DIAGRAMS.—A number of models, plans, and diagrams were exhibited around the Assembly Room.

Mr. DAVIES, of Crumlin, exhibited a beautiful model of a new steam-hammer, which he has invented. It is called the "patent self-acting steam-striker," and it can be worked either by steam, compressed air, or water pressure. The hammer can be made to strike in any direction, either oblique, vertical, or horizontal, without the slightest difficulty, and its accuracy in use has been practically proved at Messrs. Kennard's, the Crumlin Works.

Mr. H. W. MARTIN showed several diagrams, and also a model, illustrating the action of the clip pulley.

Messrs. PARFITT and JENKINS, Cardiff, had a model of a newly-invented crane in the room, adapted for loading and discharging vessels. The long arm or jib moving easily upon a hinge, enabling it to be raised or lowered at the pleasure of the man in charge, and thus immediately bringing the tub from the hold of the vessel into a line with the wagon standing close to the crane, and the chain running down lowers the contents into the wagon, where it is tipped without trouble or dust. No doubt the invention will eventually supersede the old plan of loading barrows, and wheeling them along planks, and the tipping into the wagons.——Plans were also shown by Mr. BATES, illustrating his paper on "Underground Lead."

THE PROCEEDINGS.—Mr. GEORGE MARTIN (the President) took the chair shortly after Twelve o'clock, when the minutes of the last meeting were confirmed.

NEW MEMBERS.—Mr. Dyne Steele and Mr. Cope Pearce were nominated to open the voting papers, and on their return, the PRESIDENT announced that the following new members had been elected:—J. T. Wightman, Pontypool; W. Vivian, Mwyndy; David Davies, Crumlin; Charles Gray, Mountain Ash; and A. Sutherland, Merthyr.

THE PRESIDENT'S TERM OF OFFICE.—Mr. BASSETT said he had given notice at the last meeting that he should bring forward a proposition that the President should be elected for two years instead of one. His reason for this was that by electing a President for one year, he was removed just as he became acquainted with the duties of the office. They had also precedents for this in the North of England Institute, which elected its President for two years, and in the Institution of Engineers, which elected its President every three years. He had brought the matter before the council, and it met with their unanimous approval. Having given the requisite notice, it was quite competent for them to decide the proposal to-day; and he, therefore, moved that the President should in future be elected for two years.——Mr. LIONEL BROUGH seconded the proposition, which was unanimously agreed to.

ON THE COMPARATIVE SYSTEMS OF COAL MINING IN THE NORTH OF ENGLAND AND SOUTH WALES, WITH RESPECT TO ACCIDENTS AND LOSS OF LIFE.

BY MR. GEORGE BROWN.

In this paper the writer proposes to investigate the causes of the greater loss of life in the collieries of this (South Wales) district as compared with those in the North of England, as shown in the Government Inspectors' reports. He has taken the number of accidents in each district from these reports, which he assumes to be correct, and his calculations are either copied from or based upon them. He has prepared the tabulated statement, from whence it will be seen that this district compares very unfavourably with the North in the matter of accidents and loss of life. It will be observed that, irrespective of explosions, the loss of life from falls of stone and coal is greater in South Wales than it is in the North, and in miscellaneous accidents we also compare unfavourably; of these, in the writer's opinion, certainly two-thirds in the district are what may be called tram accidents. The writer considers the great element of safety in the North to be the division of labour. Special men are appointed for special duties, whereas in this district each collier does various kinds of work, besides his legitimate business of coal-cutting. To a great extent he takes care of himself, whereas in the North his safety is cared for by a staff of officers, whose special duty it is to keep the working places, and, indeed, the whole colliery safe.

The writer proposes first to give a description of the system of mining pursued in the North, and then to compare it and its results with the plan of working in this district. He claims to have a thorough practical experience of the subject, as in the North he worked his way from a trapper-boy to the management of extensive collieries, and he had the advantage of serving under some of the most eminent men in the North of England. As manager, he has had some eight years' experience in one of the largest collieries in this district, and he claims, therefore, to speak with some authority on the subject, which he considers to be of the first importance, not only to the owners as a system of economy, but more especially as regards the prevention of accidents and loss of life. He will now describe the system as applied in the North, explaining that by the North he means Northumberland, Durham, and Yorkshire. The writer will now, as briefly as possible, call your attenton to the difference of the two systems, that of the North and that of South Wales, beginning with the former. The staff of officers that is almost universally employed in all collieries in the North consists of overmen, back overmen, and a staff of deputies according to circumstances; master wasteman, and his staff of men; master shifter, with his staff. The latter wasteman goes in at night, or fore shift. The wasteman gives his sole attention to the ventilation, in keeping all wind-ways in a proper state for the efficient ventilation of the working places up to the working headways, or board end stoppings, for which the master wasteman is held personally responsible. The shifter is engaged in keeping all the working places free from falls, renewing all timber, and securing all bad stone from the shaft to the working faces, for which the master shifter is held personally responsible. The writer takes it for granted that the two latter departments have been in at night, making all right for the next day's work; they have to see the overman and the deputies of the foreshift, and report to him (the overman) the state of their respective departments. Then the overman and half of the staff of his deputies come in at 2 o'clock in the morning, receiving the night report (we take it is all reported right); the deputies then take to their respective districts, and thoroughly examine the whole, both as to ventilation and state of working faces, and the roads leading thereto; he in his rounds sees where timber is wanted to secure any bad or unsafe stone, for be it observed he has all pitwork to set in places, and at times he can do some pressing work, such as setting doors, putting up brattices, &c., for all of which he is held personally responsible. The time is drawing near when the collier is to come in, and he goes back to the station, after having seen all right in his workings. Then come the colliers at 4 o'clock, and he sets to his task of securely locking every lamp, and dispatches them to their work. The writer begs here to call attention to the fact that not a boy has yet entered the pit. No boys are allowed to go into the face with a man on the pretence of coal-cutting, and as he has his wages to earn solely by coal-cutting alone a boy is of no use to him; he is engaged in making coal ready, and in making vantage for his partners who are to follow him. It will be here observed that the foreshift men cut most of the coal, but the backshift men fill the most; they have five hours only out of the twelve to fill coal, and the backshift have seven. All moneys are equally divided amongst the whole of the men in one place every pay Friday night, and the writer seldom or never saw a dispute on this point. All this time the overman has been very actively engaged in looking after all things on the main roads from the shaft to the stations, to see that all is in order for a regular start when the boys come in, looking to see if all horses are well, and fit to go out to work for the day; he likewise has a look at the furnaces. At a little after 5 o'clock comes the first carriage full of lads, composed of trapper-boys, drivers, and pony putters, and the overman dispatches them as they land at the bottom to their respective places; the two latter know that wherever they left off last night there they must start in the morning. The driver receives his donation of candles, if they are used; if not, he goes through the same as everyone else in the lamp department, as to examination, locking, &c. The door-boys the overman has all set down where they are to go to, and he sets them off accordingly; if candles are used where they are to keep their doors, their parents may have given them one to light them to their doors and out again, otherwise they sit in the dark, no safety-lamp being entrusted to one of those door-boys. By this time the deputies are looking out for their lads (pony putters) and door boys, if any, and by the time they get into trim it is fast approaching 6 o'clock. He has their work all placed and everything in readiness, examines and locks lamps, and all is ready for a start, and at 6 o'clock the pit commences simultaneously—at the shaft and all other places at the same time, with no difficulty to anyone. The writer may here state that the on-setters come down with the last of the lads, and if the under-viewer is coming down the pit he does so with the on-setters, after which no one is allowed to come down before the backshift men come in. At 6 o'clock precisely the first coal goes to bank, and the day's work commences, and goes on without interruption until the backshift comes in—one-half the officers (the back overman being the head), with half of the coal hewers. Only a few minutes are required, and a few more, when the foreshift men come out to ride, or go to bank; here the back overman receives the report on the spot, and the state of the whole pit, from the fore-overman. His attention is at once directed to any place reported that wants his services. The back deputy receives his report from his partner in the district he belongs to, and here his attention is at once directed to any spot that is in want of his immediate attention, and the gear is handed over to him, which consists of a handsaw, clawed hammer, and leather bag for nails, with a long-handled axe, and he at once commences his regular rounds. The backshift colliers go into the face of their places and see their partners, get an account of how many tubs they have filled, and that is all. They clear out directly and leave their partners, who have gone to work the moment the others left off. You may be sure that the locking and examing of the lamps have been gone through before those men passed the station. Now, all this change has scarcely produced a check on the regular movements of the day's work, so well and systematically is it done. The work goes on for the rest of the day up to 6 o'clock, to which hour scarcely an individual has left his work; but at the exact time everything is at once suspended all over the pit, hence all is left in a state of complete order. Everyone begins the next morning where he left off at night; this prevents confusion in every department.

The writer will here call attention to the duties of the backshift officers, who are at this time called permanently into play. The back overman sees that all horses and ponies are carefully taken into their stables by their respective drivers, and at the same time receives information if anything has happened to any horse or pony during the day. The deputy has to see that all men are out of the stations; he then has to go and look after the ventilation, see that all doors and slides are carefully closed, and then makes his way out of the shaft, where he sees the back overman, and reports the state of his district. Occasionally the deputies cannot get out in time, they may have drawing to perform; when this is the case another deputy, belonging to the nearest district, goes to assist him, and sometimes they stop a hewer or two, as the case may be. Here you will observe that the deputies have all the back timber to take out, but the back overman is quite aware of this, as he travels all back pillars, and sees those timbers all taken out. When this is the case the back overman does not see those deputies underground, but invariably sees them when he comes home, and a general consultation takes place every night between overman and deputies, with the underviewer at their head, who arranges for the next day, according to circumstances. The writer may here state that the drawing of back timber is the most dangerous of the various important branches of the deputy's occupation. The long-handled axe is here brought promptly into play in knocking the props out. This is considered extra work, and they are all paid so much per score, and they have all assistants to pay. It is of the greatest importance that those back timbers should be taken out as soon as possibly consistent with safety, both to the deputy and the safety of the working places. To the deputy it is of great benefit, as in case they let the timbers get far back they have to bring them up to the working headings without any more remuneration, as to give more price is considered giving a premium to negligence. Those timbers are used many times over, and the more handy they are kept to the face the less trouble it is to the deputy. The writer may here state that he has a lad in many instances to take the props from the station to the working places for him, but this is not generally done. The deputy sets all his pit wood, and lays rails; he seldom or never consults the coal hewer when and where he has to put in pitwood, but puts it in if it is necessary. There is always a supply in the place, cut to the length, of new and of old props, and where danger is apparent the man will not hesitate to go back and put in a few props to keep him safe, rather than be stopped by sending for the deputy, but when he returns he can tell directly there have been props put in in his absence; he examines them, and if not set right and in proper order he puts them so, as it is the duty of the deputy to see all is in ample order; it is his benefit, and no inducement is held out whatever for neglect of duty. Again, he may have got a blower of gas, or by a fall an accumulation of gas in some of his places; he puts up the usual signals, cross timbers, and all gas is cleared away at night. This is reported to the proper authorities if a large quantity is gathered and any difficulty is in the way, and a conference is held with the underviewer, overman, and deputies, and the master wasteman and the master shifter are sent at once to the spot, to use means to clear it away. This order is given by the underviewer, and is attended to at once. The case must be very serious indeed if the manager is informed of it until all is cleared and right. To inform him before action was taken would in many instances lose much valuable time—in fact, more time than would be actually required to remove the evil. When all is repaired he is told of the case, and he may go and inspect the place, see what means have been adopted to accomplish this, and that all is right. At the same time, he may point out how it might have been done otherwise, and does so carefully and plainly, and orders any little alteration to what has been done, if needs be; but he never fails to say "well done," "good," &c. This gives confidence to all, to the manager to see that he has such men under him that can and do fly to the rescue at once, and to the officers to see their prompt action has been successful and approved of by the superior. Such is the confidence of those officers (the deputies), that when a blower comes off, or a little accumulation of gas takes place, he will not leave his district at night until he gets doors set, brattice put up, or whatever else is necessary, and clears it out, and then reports it when he goes home; or, if detained any length of time, the back overman is with him. If he cannot satisfy himself, the underviewer, overman, deputies, and all others set off to see what has been done, and if all is right when they go what has been done is approved of, and the deputy commended for his prompt attention to matters dangerous. This gives an emulation to others. Foreovermen and deputies are all alive to this the next morning, and the wasteman and shifter's attention is called to it through the night. They have on all occasions such materials as pitwood, brattice, canvass, or deal, and everything for the safety of life is in excess of the demand, and kept on the premises. This is the rule, and not the exception, and it can be had on the shortest notice, even if he has to come or send to bank for it; but under ordinary circumstances he has always a supply underground, and it is not dealt out to him in begrudged quantities. There is no end of danger with half measures, and no end of cost, so that for the safety of life, and also for economy, half measures are the worst that can be adopted in mining, and of course in the North these things are not known. Is this a system worth adopting? The writer thinks it is. Where every material is dealt out with a grudging hand, and where confidence is not placed in the management by the owner, the system is bad.

The writer goes on to speak of the importance attached to the situation of deputy, who is selected from amongst the most intelligent, sober, and industrious of the coal hewers, and whose further promotion depends upon his acquirements. He must be a clever and quick accountant, or his further promotion is at an end, as the overman has all bills to make out for labour below the surface; and it depends on the spending of his leisure hours, whether well or ill, that the vital points of his future rests—at least, he has got the opportunity to do himself good if he will, which under the present system in South Wales the young man has not got. Let us see where the system of the North has such a great advantage over us and our system in South Wales, and how it is they save their men so much better than we can (this is the secret of all), or at least better than we do. In the first place, they have a staff of officers going in two hours before the coal hewers, with ample time to thoroughly examine every part. Then the coal hewer comes in two hours before the lads (not a lad in this class). The lads come in from 5 to 6 o'clock, and all go off to their well-known spots, except the trapper, and he is soon put right by the overman and dispatched likewise.

The writer next directed attention to a tabulated form which appeared in our columns of April 28, and proceeded to draw attention to the size of pit room in the North. For twice the amount of coal it is only half that of South Wales; and pit room in South Wales, in a good pit, for a reasonable quantity is almost unmanageable. What is the reason of this? It is the system, or rather no system. Their advantage is concentration. What is the inference to be drawn from this concentrated system of pit room? It is this, shown in the following:—

1.—Less pit room, there is less loss of life.

2.—Less pit room, less gas is generated.

3,—Less pit room, less windways to keep, and they are much better kept. Short runs of wind and plenty of room is the grand secret of good ventilation, and those who have least of it pay most dearly for it.

4.—Less pit room, better ventilation.

5.—Less pit room, the working face moves faster, and of course the roof is much better kept. This is one of the items of destruction to life which makes South Wales compare so badly with the North. This would reduce it to a minimum face of works.

6.—Less pit room, fewer horse roads to keep. They are much better kept from overhanging sides, which are always an eyesore, if not dangerous.

7.—Less pit room, less doors are required, and the less the better, not on account of the cost, but on account of tht dependence on them. How often when some sad disaster has taken place a door has been left open and destroyed the ventilation; being the cause of such sacrifice of life they should be dispensed with as much as possible, consistent with safety.

8.—Less pit room, less brattice and brattice wind, which is always to be avoided as much as possible. It is always in danger of being torn or broken down by tubs or trams, or crushed down by falls of stones or coal coming upon them, and the ventilation impeded.

9.—Less pit room gives a more thorough supervision of all its parts by the manager, underviewer, overman, deputies, master wasteman, and master shifter.

This system, if it produces all the above favourable results, must recommend itself; and, if these results are the cause of their favourable position, such can be held up as a model of successful mining, by which valuable lives are saved, or, as compared with South Wales, comparatively few are lost. It may be said the men will object. It may be so, but the safety of the men's lives is entrusted to our management, and if it is clearly shown that it is the system that is at fault it belongs to us to see that it is altered or improved, independent of the men, by which their lives will be more safe; and as soon as we adopt the Northern system so soon will the great disparity of life lost per ton of coal disappear. In conclusion, the writer says the modes of ventilation he has left out, as the situations are so various at different places that it is not safe to lay down any general principle, and it matters little which of the systems are applied, only get plenty of wind. Nobody that is employed under us will care how it is got, whether by furnace, fan, or vertical or horizontal ventilators. The writer may here state that there is practically little difficulty in getting wind down one pit and sending it up another, but the great difficulty is in its good distribution through the different departments of the workings, and this cannot be done except good returns are kept of sufficient sectional area; without this all efforts, however well applied, will prove a complete failure. It is difficult to keep returns of ample size for the efficient ventilation of mines, but it must be done, or the results are bad. As to the size of returns, this will much depend upon the working of a colliery opened at any one time, and a careful consideration should be taken of the ultimate distance the wind will have to travel before the colliery is driven to the far side of the boundary. Much will depend upon the life of a colliery to determine the size and quantity of wind-ways; this is actually to be looked at regardless of cost. The first cost may and does appear enormous, but it is the best laid out money by far; and if a winning will not pay for the outlay upon good wind-ways it will not pay at all. The money so laid out pays far the best, and economy on this head is often false. Where you have too little wind you get too little work done; where you have too little wind there is a great amount of mental anxiety, and this is worse than great exertion. Those who have least wind pay by far the highest price for it. You may ask how all this is to be done; alter the system, and all our present short-comings in South Wales will for ever disappear. The writer does not consider that coal mining is keeping pace with the other large interests that are so closely allied—the ironworks. They have an eye to all improvements in iron making, and adopt them, and why should we be so far behind with good examples laid before us?

The PRESIDENT said the discussion of this paper was the next business. It was a very interesting paper, and no doubt much benefit would arise from a lucid discussion of it. He called on Mr. Brough to open the discussion.

Mr. GEORGE BROWN said, before entering upon the discussion of his paper, which was based upon the report of Mr. Wales for 1864, he should like to make a few observations. He trusted the discussion would have reference as much as possible to the general bearing of the paper, and that those gentlemen indirectly but largely interested in the question, and who stood favourably on the Inspector's lists for 1864 as to the loss of life, would come forward and assist them with their experience, and give them such practical suggestions as would in future diminish the loss of life. If it was proved in the discussion that he was wrong, then the fault must lie between the management and men, and if they found that the management, men, and system were all that could reasonably be expected, then it was incumbent on them to explain away the facts and figures produced, and satisfy the press and the public that the loss of life in South Wales, in excess of every other mining district in the kingdom, was attributable to the greater mining difficulties they had to contend with. At the same time they must prove that the loss of so many valuable lives was a necessity, and that there was no known remedy to reduce the death rate. He believed no one would be bold enough to say that no means should be attempted to economise life and labour, and with these remarks he would leave the subject in the hands of the meeting.

Mr. BROUGH thought that as this paper referred to South Wales, Mr. Wales had better reply to it. He would simply remark that the question deserved their serious consideration, and as part of his district was within the county of Glamorgan, he would make one or two observations. He could not help thanking Mr. Brown for having constituted himself an unpaid inspector, and if all colliery managers were to make suggestions it would help the Inspectors and save life. The North of England did not possess such dangerous roofs and floors as South Wales, and all their seams had good tops, with the exception of the five-quarter coal. As to the division of labour recommended, he should much like to see it adopted in this district, but no doubt there would be considerable difficulty in introducing it. He should like to see more safety hands employed in South Wales than was the case at present. Mr. Brown suggested that more attention should be paid to the education of the deputies and other officers; he quite agreed with that, and had always recommended it in his reports. He was in favour of the double-shift; but as regards less pit room, he did not see how they could follow the North—at least, to the full extent. The long-wall system of working had his unqualified approval, and, if generally adopted, it would save life and economisel abour and coal. He should like to hear his brother Inspector's (Mr. Wales) views on the subject.

Mr. WALES said one great disadvantage he laboured under was the fact that he had not seen the paper. As far as he remembered, two or three leading things were recommended. Mr. Brown said work ought to be more divided. With that he quite agreed; and from his experience in South Wales and the North, he was of opinion it would be attended with beneficial results. The next point was short runs for a better supply of air, but he was sorry to say that it did not appear to be so well understood in South Wales as in the North. Then, as to propping; in the North it was done by deputy-overmen, and the plan worked well. He had before this given that matter his serious consideration, and he must say he was not prepared to recommended its adoption in South Wales. Their roofs were much worse than the North; and, as shown in the paper, the great cause of death was falls of roofs, and hence propping was a very difficult point to deal with. Sufficient care was not, in many instances, exercised as regards old workings, and cases of this nature had come under his notice, where both managers and men were to blame; the managers for not securely fencing off, and the men

for disregarding signals. Where it was necessary to use safety-lamps, he considered that the firing of shots should be strictly prohibited. If he had seen the paper, he would have been able to go more into details.

Mr. Brough facetiously remarked that his brother Inspector seemed to have a very good inkling of what was in the paper, although he had not read it.

Mr. Bassett asked Mr. Brough to give them some kind of information as to the mode of working at Pucklechurch Colliery, near Bristol. He was there yesterday, and saw a number of men going in at 2 o'clock, and on making enquiries he found there were two working shifts, and one shift of those who went in to repair the roads, set timber, &c.

Mr. Brough replied that Mr. Hadley, jun., had partially adopted the Northern system at the Pucklechurch Colliery. When they were pressed with orders, they worked double shifts, but at other times they only worked one turn.

Mr. Bassett: Three shifts—two coal shifts, and one shift for roadmen, &c.

Mr. Brough: Two shifts I should say; the pit must have time to cool down.

Mr. Bedlington said Mr. Brown's paper compared the loss of life in South Wales and the North, and he based his calculations on the number of tons worked. He (Mr. Bedlington) said at a previous meeting that that was quite a wrong principle to go upon. In many places a man would be able to work more coal than at another, and the only fair basis for them to adopt was to look at the relative number of men employed in the two districts, and then the comparison would give very different results. The Government returns for 1864 confirmed what he said in that respect. From the Blue Book issued he gathered that for every 415 tons raised in Northumberland, Cumberland, and Durham one man was employed, while in South Wales one man was employed for every 224 tons raised. These figures at once proved that the number of hands employed in South Wales must be far greater in proportion to the coal worked than was the case in the North, and hence it would follow that the fatal accidents appeared more numerous, merely compared with the get of coal. By far the greatest number of deaths arose in South Wales from falls of roof, and he presumed that Mr. Brown would admit that they had very bad tops in some parts of the district. The North was very differently favoured in this respect, and, taking out the deaths from falls, the comparison, after all, was not so very unfavourable. He had seen coal seams in the North, and, as far as his recollection served him, the over-hanging slips and riders which they had were not prevalent there. In the year 1864 the deaths from explosions in South Wales, which produced 7,000,000 tons of coal, did not exceed six, shaft accidents eight, and miscellaneous 18. The deaths from falls were 67, while in the North, which raised 1,000,000 tons, the deaths under this head were only 30. This was the most unfavourable position of South Wales. While on this part of the subject, he might state that there was another district which fairly belonged to South Wales, and that was Mr. Brough's. He referred to Monmouthshire, Gloucestershire, &c., which produced 6,000,000 tons of coal in 1864, and Monmouthshire, which was virtually part of South Wales, no doubt contributed the greater part of that. During the year, 33 lives were lost from falls, 13 shaft accidents, 12 miscellaneous, and three surface. That district showed more favourable results than South Wales, but the chief cause of death in both was the falls of roof. Why was it so? The answer seemed to him self-evident. They had far better tops in the North, and less fiery, and the men were consequently in less danger in working the coal. The thickness of the seam was another consideration. He did not think they had such thick veins in the North, and the thicker the seam the more dangerous it was to work. The Aberdare 9-feet vein was an example of that. Then they had slips, riders, and other dangerous peculiarities which were not known in the North. In South Wales they had altogether three systems of working—single stall, double stall, and long wall. Long wall was gradually becoming more generally adopted, and if that prevented accidents they were rapidly adopting it. Next, as to the number of shifts. In the North they had the double turn, and, according to Mr. Brown, it worked to great advantage. In South Wales one shift was the general rule. Working the longer hours, of course, made the men more liable to accidents. Looking practically at the point, he took it that if one man produced 3 tons in 12 hours, and another 2 tons in 8 hours, there would really be no difference, and double and single shift would come to the same result. He did not see how the double turn could be carried out, except by increasing the number of hands, and that, in the present state of the labour market, was impracticable. There were no colliers out of work; if there were he should be glad to give them employment. He found at present the greatest difficulty in getting a double shift for the headings, and there was a great disinclination to work nights. Colliers had often to wait for their trams, and if they adopted the eight-hours system a man might be unable to do almost any work from the want of trams, for just as his time was up the trams might come. Repairs were now chiefly done at night, but with a double shift this could not very well be done. All desired to have the largest quantity possible out of a pit, because the larger the quantity the less the cost per ton; but he confessed the difficulties of an eight-hour shift appeared to him insuperable. As to lessening pit room, he presumed Mr. Brown meant to shut up some collieries: and, if that were so, then, no doubt, they would have men to spare. The practical question was how they were going to accomplish all this.

Mr. Thomas Evans, Government Inspector of Mines, said he did not think the question was properly put by Mr. Bedlington, that the number of hands employed should be the criterion as to the number of accidents. To obtain the double turn, there was no necessity for doubling the number of colliers. Instead of employing 100 men at the same time, they could have two shifts of 50, and pit room for 50 would then only have to be provided. By thus confining the space of operations better ventilation would be secured, less pit room required, and there would be no diminution in the quantity raised. He had seen a great deal of the coal fields of England, and he could say that they had not a seam so dangerous to work as the Aberdare 9-ft. He quite agreed with Mr. Wales, that much of the danger attending the present system of working arose from the badness of the roofs, and the fiery nature of many of the seams. Of all systems long wall was undoubtedly the best, and in other districts the thickest seams were being successfully worked with it. Under it there was no limit to the quantity; it was only a question of labour. He knew collieries in the Midland Counties working over 1000 tons per day, and one actually produced 2000 tons. In looking at the number of accidents in the different districts one year's return was hardly a safe basis—they should take, in his opinion, ten years' returns.

Mr. Bedlington said they could not make a ten years' comparison, for the number of men employed was not given in the Blue Books previous to 1864. In 1864, he found the deaths in proportion to the number employed were as follows:—North of England, 1 in 354; Yorkshire, 1 in 627; Derby, 1 in 403; Monmouthshire, 1 in 397; South Wales, 1 in 277.

Mr. Wilkinson said that he had often told the colliers under him in the Aberdare Valley that he would not work a day under the present system. He would give them his reasons for this. People on the surface generally lived longer than those working underground; and why? Men who had been 20 or 25 years underground working with a safety-lamp he generally found their eyesight affected, and he had sent many to the hospital. If they were employed a little less time underground—eight hours instead of twelve—then there was no doubt their eyesight would be preserved longer. The early age at which colliers commenced to go down the pits was another drawback, but with shorter hours they would have time to improve and educate themselves; and he knew many in the North who had progressed in this way. Great efforts were being made in the North to educate the hands, and the double turn gave the men time to look at their books, and colliery managers were to be found who had risen through their own exertions. In South Wales there was little of this, but with a double shift he believed education would be more attended to. He had tried the system some years ago for three weeks, the men admitted that they liked it, but they did not relish the idea of getting up so early. He had told them that eventually—in the next generation, perhaps—the eight-hour system would be certain to be adopted. He did not think Mr. Bedlington comprehended the paper clearly as regarded quantity and the number of men. More hands would not be required—it was simply a division of labour that Mr. Brown recommended. As to ventilation, he believed that they all agreed that the lessening of pit room would increase the supply of air. He thought that the number of accidents by falls would be reduced one-half by the double turn. He disputed the assertion that the tops were so much better in the North; the system of working necessarily made the roofs worse. If he could work his long wall here as in the North, that would have a great influence on the top. Here he could not move his work more than 1 ft. per day, and there 3 ft. In the North the stall were about 4 yards wide, and here 8 yards. That made a great difference, and affected the roof. But, even with the extra width, if they moved a little faster they would not bear so unfavourable a comparison with the North. The quickness with which the coal was worked there was the great cause of the small number of accidents. Stalls and headings stood about four months in the North, and here two years; hence the top became bad. The Queen herself would not be able to induce the pitmen of the North to stop twelve instead of eight hours underground. The same number of horses would do for the double turn, delays would be averted, and both proprietors and colliers would be benefited if the system were adopted. They would then have their big hauliers gradually becoming colliers, and the boys would be in the fresh air driving.

Mr. John Williams advocated the long wall system in preference to the pillar and stall, but he was quite opposed to a double turn. With a double shift the coal would be worked too soon, especially with them at Lletty Shencyn, and he knew from experience that the extra time for recreation given to the men would not be made use of for educational pursuits, except in very rare instances. Their bad top was, without doubt, the cause of so many accidents, and the thicker the seam the greater the danger. He had frequently accidents in the 6 and 9-ft. veins, but none for a long time in the thinner seams, which was a proof of what he had said. Generally the roof was worse where the superincumbent weight was great, such as under a hill or mountain. The fire was as bad under the flats, so that he did not think the gas had anything to do with the top being so dangerous.

Mr. Thomas Evans begged to correct one remark made. If they took an average of 10 years, as suggested by him before, they would find the Derby district stood far more favourable than in 1864. Ten years was the proper criterion.——[Mr. Bedlington: I quite agree with that.]——Mr. Evans continued, and said he did not agree with Mr. Wilkinson that their roofs were as good as the North. He was quite certain that the Aberdare and Merthyr tops were far more dangerous than any in his present district (Derby). No system could do away with a bad roof. The pressure of gas in the coal seeking to escape had much to do, in his opinion, with the bad roof. There could not be two opinions that by the pillar and stall a large quantity of coal was wasted, and the adoption of the long wall could not fail to be a great advantage. He quite differed from Mr. Williams's conclusion as to the disadvantages of the double turn.

Mr. Brough expressed his belief that long wall could be generally adopted in South Wales, and as to the double turn, he admitted that it had many advantages, but there would be great difficulty in applying it. There was an allegation that they killed more people in South Wales than the North, and it was their duty to explain that. The tops of the North were far better; were pretty nearly all, in fact, something like their best—the Mynyddslwyn. They had only one seam with a bad roof in the North, whereas he unhesitatingly said they had the worst roofs in the world in South Wales. Then he came to the conclusion that it was their bad stratification which was the main cause of the large number of accidents.

Mr. Wilkinson referred to instances where the rock was bad in the North. He urged that a combined effort should be made to introduce the double turn.

Mr. Bedlington said if they could get as much work done in eight hours as twelve hours, the double shift would be an advantage; but it had to be proved whether the same amount of work would be done. He was surprised to hear that any difference of opinion existed as to the South Wales top being far worse than the North—undoubtedly it was worse. He fully agreed that it was desirable that the coal should be worked quickly. Dividing the earnings, as practised in the North, would be a very difficult point, and he did not believe they could get the men to agree to it. The big hauliers could not be dispensed with, for when trams got off the plates, and other accidents occurred, how could boys manage them? And if they made the colliers' work so attractive to the haulier, where were they to get the latter class? He did not dispute that the double turn would be advantageous in many ways, but the question for them was not what they desired to adopt, but what, under present circumstances, was practicable and possible.

Mr. Wilkinson remarked that if they could only convince the men there would be no difficulty. Colliers in South Wales would work as well as in the North. Even now, although the men were down ten or eleven hours, they idled about, and did not work in the face more than eight hours.

Mr. Bassett thought it advisable to further adjourn the discussion, as it was so important a subject. The cost of maintaining the roads under the present system was a heavy item, but if the coal were worked quicker the roads would no longer be required. By the next meeting he would be able to get statistics of the cost of maintaining roads.

Mr. Menelaus believed if they could come to a practical conclusion, it would be useful if the time of three or four meetings were occupied in the discussion. The workmen, masters, and country at large would be benefited if they could devise effectual means of saving life. He had no sympathy with the opinions of Mr. Williams, that they would work the coal too rapidly by the double turn. When a pit was sunk, the main object was to get as large a quantity out per day as possible. He doubted whether there were any collieries in South Wales that raised 600 tons per diem on an average.——[Mr. George Brown: Yes, one at least.]——Mr. Menelaus said there might perhaps be one. In other districts, such as the North and Midland Counties, where the double shift was adopted, it was quite common for collieries to produce 1000 tons. In fact, they had heard to-day of a pit raising 2000 tons per day, and he was informed that there were many in the North whose output reached 1300 tons.——[Mr. George Brown: Quite right.]——Mr. Menelaus continued, and said they did not raise this quantity merely on a Wednesday, Thursday, and Friday, but this was the average output. The capital expenditure in South Wales was very heavy, and yet they were unable to produce so much coal as other districts. It was their duty to try and put an end to this, and let them see whether they could not introduce the double shift. He could understand, if theirs were an agricultural locality, where men worked from six to six, that it would be difficult to establish two shifts. At the ironworks the puddlers had the double turn, and why should the colliers object? A determined attempt should be made to break down the present system, which was so unfair and expensive to the master and injurious to the men. Under the present plan he questioned whether the colliers really worked hard for six hours, reckoning six days to the week. What Mr. Brown suggested was that the men should go down for eight hours, and for that time they must work. At present, when labour was so scarce, it would not perhaps be judicious to make the attempt, but they should wait their opportunity. It was a disgrace to the district that only one pit raised 600 tons per day.

Mr. N. Scott Russell suggested that if the discussion was adjourned, it should be understood that a member could only speak once on the same subject. That was the practice in other institutions.

The President coincided with Mr. Russell.

Mr. Bassett's proposition to adjourn the discussion was then agreed to.

The paper "On the Colerton District of the Leicestershire Coal Field," by Mr. George Lewis, was very lengthy, giving the position and area of the district, the nature of the coal, details of the veins, and mode of working. There was no discussion on this paper. A vote of thanks was unanimously awarded to Mr. Lewis.

Papers Read.—Mr. Bates on "Underground Lead," Mr. H. W. Martin on "The Clip Pulley," Mr. R. Bedlington on "The Duration of the South Wales Coal Field," and Mr. Loam on "The Cornish Engine."

Mr. Brough said he had looked into Mr. Bates's calculations, and could verify their correctness.——Mr. Bassett said the colliery referred to by Mr. Bates was one of Lord Tredegar's, and he was much pleased with the plan advocated. As Mr. Martin's paper was an analogous one, he moved that both should be discussed together at the next meeting.——This was agreed to, and votes of thanks were accorded to Mr. Bates and Mr. Martin.

The discussion on Mr. Bedlington's and Mr. Loam's papers was also adjourned until the next meeting, and a vote of thanks was given to each.

Mr. Bedlington calculated that in South Wales, including Monmouthshire and excluding Pembrokeshire, there was 21,100,000,000 tons of unworked coal, in seams of 2 ft. and upwards. At the present rate of extraction this would last 1918 years, and it would supply the total requirements of the country for 229 years. He estimated the depth of the basin at 1000 yards, and they had already pits in Lancashire 700 yards deep; therefore, with the continual improvements made in machinery, he did not apprehend any difficulty in going down.

A vote of thanks to the President and other officers of the Institute brought the proceedings to a close.

After the meeting, the members and friends dined together at the Royal Hotel, and the usual loyal and other toasts followed.

APPLICATION OF IRON TO PIT-HEAD FRAMING AND ENGINE SEATS.

A highly valuable and interesting paper has been read before the Institution of Engineers in Scotland, by Mr. Walter Neilson, of the Summerlee Ironworks, the object being to direct attention to an application of iron worthy of consideration from an economic point of view, as well as for the increased security it gives to those whose lives are so much dependent upon it. Hitherto it has been the universal practice to construct pit-head framings of wood, with all its disadvantages. A wooden structure, however well constructed, is but temporary, and its destruction within a certain period inevitable, when, as is generally the case, it is exposed to the action of a variable climate such as ours, and little attention paid to its protection. But there is another cause of destruction to which wooden structures are liable, and from which, under the circumstances, iron would be secure—and that is fire. It was such an accident, with the consequent calamity, which first induced Mr. Neilson to direct his attention to the subject, and resulted in his substituting iron for wood.

Besides the pithead frames, Mr. Neilson has adopted iron for engine-seats and gearing-walls, &c., instead of wood or stone, as formerly, and has found it to answer all his expectations. The cost is not more than half that of stone, is even less than that of wood, while it answers the purpose much better than either. Mr. Neilson gives the details of malleable iron pit-head framing and cast-iron engine-seat, bell-crank beams, and gearing-wall, erected at Shielmuir, near Wishaw, in 1864. The pit-head frame, made of channel-iron bars, and weighing $73\frac{3}{4}$ cwts., cost 78*l.* 16s.; the cast-iron engine-seat, bell-crank, beams, and gearing-wall, $20\frac{1}{4}$ tons, cost 142*l.*=220*l.* 16s. A timber pit-head framing of equal dimensions and stability, with the requisite mounting, would cost 50*l.*; and timber engine-seat, &c., including the necessary bolts, washer-plates, and bell-crank beams and washer, would cost 228*l.*=278*l.* Showing for the whole erection a saving of 57*l.* 4s. in favour of iron as compared with wood. If the engine-seat, gearing-walls, &c., were of stone, with the necessary wall-plates, binding-bolts, &c., they would cost 273*l.*, showing a saving in favour of the iron erection of no less than 102*l.* 4s. Another instance of an erection at Knightswood was given, where the wrought-iron pit-head frame and cast-iron engine-seat and gearing-wall cost 78*l.*, whilst a timber pit-head frame and stone engine-seat, &c., would have cost 100*l.*, thus showing a saving in favour of iron of 22*l.*, or more than 20*l.* per cent. Mr. Neilson expects cast-iron to be superior to the malleable iron frame in point of rigidity, and to cost less. He observes that those who have not had experience of cast-iron engine-seats, gearing-walls, &c., may doubt their stability, but he can assure them that in this point, as in others, they are superior to either stone or wood. And if it should be considered necessary to increase the weight of the engine-seats, that can easily be done by filling up the inside with broken stones or concrete, and thus making it practically a monolith, and superior in every respect to blocks of stone, however well bolted together.

One advantage which the application of iron to such structures has, especially to ironmasters, is that, unlike other materials, the value of the iron, instead of diminishing, is probably increasing, so that instead of having to renew a wooden structure within a limited number of years, and find the old materials valueless, the value of the iron in twenty, or perhaps in a hundred years, will most likely be much above what it is at present. The author, therefore, submits that in point of economy in first cost, its greater efficiency and durability, and the probably increasing value of the materials, iron is much to be preferred to any other material in structures of the class referred to, and beyond this, even to suggest the question of building the quay walls and docks of iron. Mr. Neilson does not presume that the various pit-head framings and engine-seats, which he has constructed of iron, are by any means perfect in design, or that they have even satisfied his own ideas of what they should be; but he considers the success he has achieved, and the importance of the subject, such as to warrant him in bringing it forward, with the view of eliciting the opinions of those more able to judge of such matters than he is, and by the aid of such advice, to advance a branch of engineering of much importance.

Mr. Alexander had seen one or two malleable iron pit-head framings, and they were excellent, and superior to a wooden erection. He had not seen any made of cast-iron; but if they were not liable to be fractured from a sudden jerk, he could see no objection to them, iron being preferable to wood as regards wear, and much safter as regards fire. The accident referred to in the paper was a very severe one. The flames broke out below, and soon reached the surface, and the framing was burnt before the miners underground could be got out. The use of iron for engine seats had also come under his notice, and he had found it to answer well. In consequence of the horizontal strain due to the working of the bell-crank, it was difficult to keep the joints of a stone foundation tight. This was avoided in the iron, as the whole was made as one piece, and those plates, although not much weight, worked very steadily. They were usually merely a case 1 inch thick, filled up with the shale that came from the pit; the two pumping-engines which he had seen worked well.——Mr. A. Inglis had no doubt iron frames would be more durable than wooden ones; and in the cause of humanity he thought it would be highly desirable to use either malleable or cast-iron. He was afraid, however, that cast-iron would require to be made so heavy that it would be best to use malleable iron for frames. He was of opinion that the first cost would be so large as to prevent any very general use. Also, the temporary nature of such erections would prevent its common use. After all, he thought it would come to be a question of cost.——Mr. Hamilton said that, although pit-head framings were of iron, still, on such an occurrence as that referred to in the paper, the rope would burn, and thus prevent the men getting out.

Mr. Faulds said that there could be only one opinion as to the utility of using iron for pit-head framings. He had very considerable doubt, however, as to the economy of using cast-iron, more especially for engine-seats. Where a great pump was attached, the engine-seat must have weight, otherwise it could not stand the severe strains it was subjected to. He did not think that they could procure cast-iron ton for ton with masonry. He thought the matter would prove to be one of expense.——Mr. Alexander, in reply to Mr. Inglis, said that instead of being an objection to the use of iron for pit-head framings, the temporary nature of those erections made it the more suitable, seeing they could be so easily taken down and refitted up. Wire-ropes had frequently been used, so that the objection of the ropes burning might be removed.

Mr. A. Gilchrist remarked that even were the rope burned, another could easily be got, and little time lost, if the framing were standing. He highly approved of the use of iron framing.——Mr. D. Rowan said that his own opinion was that the iron was cheaper, and as for the use of it there was no comparison between it and wood. As to its use for the foundation of a pumping-engine, nothing could be better. He believed there was nothing tried the foundation more than the action of the bell-crank. Stone foundations were difficult to keep in order, and iron seemed to answer exceedingly well.

Mr. W. Smith remarked that, notwithstanding what Mr. Rowan had said as to the question of expense, he was of opinion that it was quite a matter that should be enquired into by them. His opinion was that the framing would be found to be nearer the price of wood than the engine-seat. He could not see how the framing could be made for the same price as timber. He thought that when the paper set forth that the iron framing and engine-seats could be made from 20 to 50 per cent. cheaper than wood and stone, they should judge whether that was so. He would be glad to see an iron engine-seat made as cheaply as one of stone. He was certainly startled with the figures; but, at the same time, he looked upon it as a very valuable way of introducing iron.

The President said that Mr. Duff had used cast-iron boxes for engine-seats, and his experience was that the iron engine-seats were the cheapest.——Mr. W. Smith replied that no one could persuade them of that hitherto.——Mr. Faulds believed that a cast-iron box, would do well enough; but whether it would be more economical was the question. If the box were filled with concrete attention must be paid to the kind of stone and cement used.——The President said that if the tie or strut between the bell-crank and the engine foundation were sufficient very little weight was necessary.——Mr. W. Smith was not aware that the tie was between the bell-crank and the engine-seat—it was very proper to form one continuous tie.——Mr. Faulds said the whole strain must be supported from the engine-seat, and with a pumping-engine weight was required in proportion to the work to be performed. Without that ties would be of little use.——Mr. Alexander said the wall-plate below the bell-crank was shown in connection with the engine-seat; this was generally the case. The length might be 16 ft. or less, but he did not remember an instance where the connection was not carried along from the engine-seat to the bell-crank.

Mr. W. Neilson admits that Mr. A. Inglis's opinion regarding the preference of malleable iron to cast-iron is the popular one, although there is a difference of opinion as to this. He is of opinion that for structures of moderate dimensions cast-iron is preferable, being more durable than wrought-iron. The success of Southwark Bridge advocates strongly for the use of cast-iron. In recent engineering practice, where bridges are made hundreds of feet in span, malleable iron is preferable, on account of its greater adaptability to the various modes of construction. A pumping-wall of masonry, built up of a number of separate blocks, requires great weight to enable it to resist the various strains to which it is subjected. A pumping-wall of iron does not require to be supplied ton for ton with stone, as suggested; hundredweights for tons is probably nearer the truth. As to cost, the weight of iron is given, and a sum put opposite, so that it is open to fix the cost according to situation. The work in erecting an iron frame is not much more than in erecting a wooden one, and the work in constructing a stone seat a great deal more than an iron one. An iron engine-seat, by means of the dove-tailed joggles and flange-bolts is made, as it were, one piece throughout, both vertically and horizontally, whereas the individual pieces of a stone building continue disunited, and a stable effect is only acquired here by the heavy dug-bolts and cast-iron foundation-plates used to bind them together. Hence the very great superiority of a cast-iron seat over one of stone.

MINERAL RESOURCES OF ITALY—No. II.

The iron industry of Lombardy is the most important in Italy, in regard to the variety and the quality of its products. The ore of the Lombard Alps still furnishes metal of the utmost tenacity for the manufacture of cannon and other fire-arms, and steel for the production of swords and bayonets, which are now manufactured in the province of Brescia by tens of thousands. And there is ground to hope that to these branches of industry may soon be joined that of meeting the larger and more modern requirements of the navy and the railroad. The total production of the country is about 15,000 tons annually. Among the various causes which have led to the whole of this metalliferous district being much less productive, and to a still greater degree less profitable, than it might have been, has been the bad, intricate, imperfect, and changing legislation by which mining property has been governed.

All the mining property in Lombardy is in private hands. Many mines are possessed and worked by individuals, some by partnerships, and a few of the more important by joint-stock societies of a larger kind. In the majority of cases the proprietorship of the mines is based on rights derived from a remote antiquity. The earliest notices of mining operations date from soon after A.D. 1000. The mineral treasures of the soil were at that time considered to be royal, and the royal and imperial lords seem to have granted them mostly to the bishops of the districts in which they were situated. These granted them in turn on various terms to the inhabitants of the lands on which they were situated, and by 1300 they seem to have become definitively the property of these latter persons. The earliest legislation on the subject which has been preserved is found in some of the communal codes of law, which in the first half of the fourteenth century began to regularise and to be founded on the pre-existing local customs, which in default of more formal legislation had previously stood in the place of law. The French and German laws were in turn introduced and abandoned, and everything was in a state of the utmost confusion, when the present Italian Government succeeded to the task of ruling the country. This Government has since been vigorously striving to put matters on an improved and more satisfactory footing. Great difficulties were met with in the first instance, but satisfactory progress has been made. Thirty years' possession has been recognised as constituting a sufficient legal title. And the present great object of the Government is to favour, if not compel as a measure of public weal, the union of the very numerous groups of small owners into companies, large and powerful enough to carry on the mining operations with all the advantages of modern method, sufficient capital, and enlightened, and at the same time economised, direction.

The work of mining is carried on mainly during the five months from Nov. to April. At the highest mines the miners establish themselves early in Nov., in huts built close to the mouth of the mine, taking with them food, powder, and other necessaries for the work during the entire season. The fall of snow is often so great that nothing whatever of the men or their huts, or the mines, is to be seen above the surface, and the miners are obliged to bore holes in the snow above their dwellings, in order to get air and light. It might be supposed, remarks Signor Giordano, that such a life would be miserable and unhealthy. The reverse, however, is the fact. The miners are a healthy race, and the occupation is much sought after. They work for the most part in companies of two, attended by one or two boys, who carry the excavated mineral to the mouth of the mine. During the other months of the year only a few men are left at the mine, for the conducting of the operations of roasting and bruising, which are performed during the summer on the ore that has been excavated during the winter. The mining population in Lombardy is of two sorts. The most numerous class are miners only in the winter, returning during the summer months to their primitive occupation of agricultural labour. These men receive 1 fr. a day. Some of the mines, however, are worked by professional miners, who are paid 2 frs. a day. But it is said that the employment of them is more economical than that of the other class. Those labourers who are not miners, but only carry the mineral, as well as the children, both male and female, employed, receive only from 40 to 60 centimes a day. Sometimes, however, the mining is done by piecework, but not when the mine is but very little productive, or when it is desirable that the ore extracted should be of select quality. In general the mining operations are carried on entirely according to the caprice or judgment of the working miners, without plan, without method, here and there, up and down, as the changing appearance of the soil may seem to invite them. In some cases there is a captain, called maestro, who has the direction of the works; but he is a man without instruction, and without even much authority over the workmen, and his only object is to please his employer by obtaining as large an immediate product as possible, without any regard to the future. Of course, the result is that the greatest waste and mismanagement prevail. Many of the mines have not even any plan of the workings; and the proprietors and all concerned in them are so utterly ignorant of everything concerning them that it frequently occurs that after running a gallery with much labour and cost, it is found to lead to huge caverns from which the mineral has been long since extracted by ancient works. And the knowledge that such is often the case, of course, operates to discourage and prevent works of the kind from being undertaken. The doubt as to the limits of claims, and the flooding of the mines, are also frequent preventives of working, so that it will be easily understood how very much greater returns might be obtained by a few reforms, and a greater power of capital.

The cost of excavating the ore varies from 35c. to 60c. per quintal (say 2s. 9d. to 4s. 9d. per ton), and the transport of it to the mouth of the mine, done for the most part on men's shoulders through long and winding galleries, is generally very costly. The work to be done during the summer months, when the mining is suspended, at or near the mouth of the mine, before the mineral is carried away to the smelting houses, consists of breaking it up, rejecting that which is not worth further labour, roasting it, and subjecting the roasted metal to a second and more accurate process of selection, for the rejection of much worthless

or injurious matter that is more easily separated from the mineral after the roasting process. The labour involved in these operations at the mouth of the mine may be put down at from 17 to 20 centimes the quintal, or 1s. 6d. the ton. All this portion of the work is very rudely and disadvantageously done. A great saving of fuel would result from substituting a system of continuous fire for that of intermitting fire, universally adopted. But, says Signor Giordano, it would be very difficult to persuade these mountaineers that such would be the case. The roasting process, moreover, is very badly done, some of the contents of the kiln being insufficiently, and other parts too much, acted on by the fire. The mineral thus broken, roasted, separated from the separable portion of worthless material, is reduced to fragments of about the average size of an egg, and is in this state transported to the smelting furnaces. This transport, in most cases attended with considerable difficulty, by reason of the mountainous situation of the mines, and the difficult nature of the intervening country, is generally executed in three stages by as many different means of conveyance. The subjoined are examples of the total value of the roasted and selected ore per quintal when brought to the smelting furnace. It is to be noted that nothing is set down for expenses of general direction of the works, which in most of these small enterprises is infinitesimal; and further, that most of these mines being worked abusively, and illegally (according to the provisions of the new law), and without regular concessions, they pay no tax, or scarcely any:—

Corregiata	Mine at	......	Scilpario smelting house		......	12·47 frs.
Colli	"	......	Scilpario	"	......	12·71 "
Vivione	"	......	Scilpario	"	......	13·03 "
Manina	"	......	Bondione	"	......	24·83 "
Pisogne	"	......	Pisogne	"	......	12·80 "
St. Aloisio	"	......	Collio	"	......	10·11 "
Penedoletto	"	......	Premadio	"	......	15·88 "
Montescheno	"	......	Montescheno	"	......	21·00 "
Gaeta	"	......	Dongo	"	......	31·45 "

The number of workmen of all classes employed on the mining, selecting, and roasting of the 30,000 tons of ore produced is about 980, and their wages average 11d. (1·14 fr.) per day. The total cost of the above mass of mineral at the pit mouth is about 332,000 frs., and when delivered at the smelting houses, 470,000 frs., thus giving for cost of transport 130,000 frs. Thus we have per quintal—Labour, 1·0 fr.: other expenses, such as materials, &c., 0·36 fr.; carriage to the furnaces, 0·52 fr.: showing the average cost of the mineral at the smelting houses to be 1·88 fr. From these data it is evident, says Signor Giordano, that a very notable economy would result from better methods of working and means of transport. Thus, taking the mines of Manina, in Val Scalve, in the province of Bergamo, for an example, Signor Giordano is of opinion that the association of the small mine owners, improved drainage, and a better system of excavation, would reduce the price of bringing the mineral to the surface from 0·877 frs. to 0·350 frs. per quintal; and in the case of the Valle Mines, near the Lago d'Isco, in the province of Brescia, from 1·059 frs. to 0·370 frs. Very notable saving might alse be effected on the cost of transport from the mines to the smelting houses.

With regard to the supply of peat, lignite, and that inferior sort of coal found in considerable quantities in many parts of Italy, it is considered that the Lombard provinces may be estimated to possess more than 1500 hectares of peat deposit, which may be calculated to be capable of yielding 40,000,000 quintals of dried peat. And the greater part of this is so situated as to be within available reach of the ironworks. The best system of preparing peat seems to be that adopted by Signor Badoni, at Bellano. The peat is there subjected to a pulping process, which is effected by a machine working in a tank full of water. The earthy matter falls to the bottom, and the peaty and combustible portion is carried by the water into rectangular receptacles, where the moisture is allowed to drain from it, and the remaining mass of peat is cut into rectangular pieces, which are afterwards dried either in the open air or under roofs. The requisite machinery costs 11,000 frs., and is capable of preparing 28 cubic metres of moist peat per diem, at an expense of 1 fr. 80 centimes per cubic metre, all items of cost included. It employs ten men. The cubic metre of peat thus prepared weighs, when dry, on an average 210 kilogrammes, whereas the unprepared peat would weigh only 150 kilogrammes. Thus the cost of preparation comes to 86 centimes per quintal, of which 30 centimes is for labour. But this system of preparing peat might be carried with advantage to a much higher degree of perfection. This is done on a large scale at Scheissheim, near Munich, where, by steam machinery and a system of compression between rollers, somewhat similar to the working of a paper-making machine, a peat fuel is produced of a density equal to that of wood. And this product can be supplied at a cost under 90 centimes the quintal. The peat prepared in this manner is of a black and much decomposed kind. And the method would not be be applicable to more fibrous peats, such as are the majority of those of Lombardy, unless the material were previously broken up. Prof. Morro has, however, in the course of a great number of experiments on the Lombard peats, succeeded, by very simple means, and at small cost, in producing a very valuable fuel, weighing 600 kilogrammes and more the cubic metre. The total cost is about 1 fr. the quintal.

Only one mine of lignite exists in Lombardy, at Gandino, in the district of Clusone, in a branch of the Val Seriana. The deposit here, however, is very large, extending over a superficies of 500 hectares, and having a thickness of 7 metres. This lignite is of the kind designated as peaty, and of post pliocene age. This fuel can be delivered at Lecco for 2 frs. 40 centimes the quintal; and there is room to hope that this expense may be diminished to 2 frs. The fuel is not available for the first smelting of the mineral; but, as Signor Giordano observes, it is none the less of very great importance to the Lombard iron industry, if only because it affords for a very long time to come the means of sparing many millions of quintals of wood or charcoal. Neither the peat nor the lignite, as has been said, is available for the first reduction of the ore. A fossil coal has recently been found in Friuli, to the north of Udine (now to be Italian territory), which is said to be capable of furnishing coke. And it may be that this will hereafter exercise a notable influence on the Lombard ironworks.

WHAT IS COPPER USED FOR IN INDIA?—No. III.

The quantity of copper worked up in Birmingham, as explained in our last, represents but one portion of our home copper trade, and we must add to the amount disposed of in that market from 4000 to 6000 tons for that copper which is worked up by manufacturers into the same class of articles as are made in Birmingham, but in manufactories scattered over England. To this must be further added that copper which is sold by the smelters direct to home consumers, such as locomotive engine manufacturers, &c., (say) from 3000 to 5000 tons per annum; and, to conclude the total of copper used in the home trade, we must mention that 7000 tons of copper are converted by the smelters into yellow metal at their works.

Of the foreign markets to which we send copper, that of British India is by far the most important; and, as we look very much to the demand from that quarter as a guide to the future price of copper, it is well worth while to investigate the character of our commerce generally with India, for if we confine ourselves to our copper trade alone we shall fail to appreciate the causes of the undulations in the demand during the last three years. To none of England's dependencies can Englishmen turn with greater pride than to India, and this despite the many dark pages which blot the history of our connections with her, for there we see a great people striving by English aid to develope the natural resources of their favoured land, and to substitute the higher aims of civilised man for their old barbarous ways and customs. Not only, however, has Great Britain the glory of seeing the great work of civilisation brought home by her rule to one of the greatest of eastern nations, but she has also the practical advantage of deriving from her possession of India a powerful means of developing her own commerce. Now, there is something peculiar and remarkable in our relation with India, for we have not in any way colonised in that country, and we can, therefore, but consider the provinces we hold there as so many dependencies, since the only English residents there are included under the three following heads, to one or either of which all the Englishmen in India belong. They are —the English army of occupation; the English civil governors and authorities; and, thirdly, the English merchants who reside there for purposes of trade. There are no English labourers in any part of India, the whole of the heavy work being performed by the natives. The peculiarity of our relations, then, with India is just this—that it is almost the only country that a European nation has ever ruled where a semi-barbarous native population has continued to exist under that rule, and even prospered. In almost every other case where a European race has occupied a country similarly situated, there the native race has dwindled away and disappeared before its tread. That this general rule has been reversed in India is due, probably, to the fact that when we entered into occupation of that country there existed among the native population a large number of men of superior mental cultivation, whose influence for good on their more ignorant fellow-countrymen in furthering the cause of civilisation can hardly be over estimated. No one can deny that in our dealings with the superior castes amongst the native Indians we have outraged their time-honoured customs; still, whilst we have done this by military compulsion, our merchants have at the same time taught them the practical advantages of commercial prosperity, and have found ample reward for their labour in the aptitude of the natives for commerce.

The capabilities of India, from a commercial aspect, have up to this time been barely tested, but we have had a remarkable instance of her capacity in one direction at least—that is, in the power of producing cotton, as shown in the quantity she has exported since the outbreak of the American war; and, undoubtedly, if our Government had thought it wise to encourage the growth of cotton in India, by offering especial advantages by means of protective tariffs to the native growers in their competition with the other markets that supply us, the result would have been still more remarkable than it is, but our Government, most rightly, did not consider such a course wise, and, therefore, to the enterprise of the merchants alone is due the great work of growing cotton in India. Our Government did, however, recognise the paramount importance as a civilising agent, as well as a means of spreading knowledge, of all facilities for intercommunication between the more distant parts of the empire, and so has fostered the making of railroads throughout India, by guaranteeing a dividend of 5 per cent. per annum on all the capital expended in their construction. Conceiving for a moment the actual state of the native population at the time we entered into possession of India, and comparing such with the mode of life of a European population, it is possible to form some idea of the great demand for all the appliances of civilised life which the spread of European tastes would bring about. Thus it is that each new railway which bisects this populous but semi-wild region is not only itself a customer for our metal manufacturers, but also is a means of carrying to every village along its track our English manufactures and productions, and until local manufactories shall spring up in those far-away regions—an occurrence uot likely to take place for many long years to come—India will still continue to be one of our most important metal-consuming markets. Thither we sent from England, in 1863, 10,000 tons of copper and 5000 tons of yellow metal; in 1864, 12,500 tons of copper and 4000 tons of metal; in 1865, 6500 tons of copper and 5000 tons of yellow metal; adding to these figures 2000 tons of copper for that amount annually sent to the same market by our Government for coinage and other purposes, we have as absorbed by India for the year 1864, 14,500 tons of copper; and for the year 1865, 8500 tons.

This short summary of India's demand for English copper is a remarkable illustration of the many apparently unimportant causes which affect at times all trades. In the above figures, the most remarkable point is the fact that India took from us during 1864 just double the quantity she bought in 1865. At first sight it is difficult to account for this astounding difference, especially when we supplement it by the statement that the stocks of copper in Bombay in the beginning of 1865 were smaller than in the beginning of the year 1866, when there was in that one port alone more than 3000 tons. If, however, we go a little further to seek the cause of this extraordinary fluctuation, we shall find it solved in our cotton trade with India; for when America could no longer, from her own civil wars, continue to supply us with cotton, India was at once seized on as the best country for producing the article required. Now, as the native Indians were too poor to undertake the work of planting without advances in coin as a mortgage on their future crop, so it became necessary to send from this country considerable quantities of specie to stimulate the work of planting. This influx of capital produoed a feeling of over-confidence in the commercial world of India, and merchants began to speculate with frenzy. It being further found that when the cotton was grown, the natives demanded payment for it in metals, of which copper was the most important, many merchants exported copper to India on speculation. Well, when the American war suddenly ceased, and the price of cotton fell so enormously, a commercial crisis fell on India generally, and on Bombay especially. The numerous bubble schemes which had found dupes to support them suddenly broke, and the good and wholesome trade suffered in the general panic. As might be expected, this state of things in India, despite the distance between us, re-acted on our markets here, and produced an unparalleled depression in the value of those articles which India especially consumed. Copper suffered heavily, and it became for a time a drug in the Indian market, simply because the chief part of that which was got rid of in that market in 1864 was got rid of in the form of payment for cotton, and cotton being no longer required, so also did the demand for copper diminish in proportion.

Now, we all know that the want of confidence which succeeds every commercial crisis is not easily allayed, and it is undoubted that the Indian markets are still suffering from the panic of last autumn. Our late monetary panic here also can but have a prejudicial effect on the trade of India. Still, despite these counteracting effects, our trade with the East must, when time shall have restored commercial credit, return to at least that condition in which it was before anybody thought of its being a large cotton-producing region, when, in fact, India consumed more than 5000 tons of our copper annually, besides yellow metal. It is, indeed, impossible to believe any other than that as surely as progress is the inevitable law of the human race, and that progress in a commercial sense means extended trade, and an enlarged demand for all articles of necessity, refinement, and luxury, so surely shall India not only continue to consume such quantities of our productions as heretofore, but also shall, as civilisation spreads from end to end of her land, demand increased and increasing quantities.

CORNWALL: ITS MINES AND MINING—No. II.

PAST, PRESENT, AND PROSPECTIVE.

In the last article it was stated that the price of tin fell in 1788 to 58l. per ton. About this period Mr. George Unwin, purser of an East Indian ship, called the attention of the East India Company to the low price of tin, and to the profit certain to accrue from an exportation of that metal to China and India. In 1789 the company exported a small quantity, and were so well satisfied with their speculation that they made arrangements for securing a continued supply. This fresh demand naturally raised the price in Cornwall; but the Cornish Associated Tinners, seeing the advantage of gaining a sure market for part of their stock, created an artificial system, by which the East India Company were supplied at a low price, while the price in the home market was kept high enough to make up the deficiency, so that the manufacturers of England paid much more dearly for their tin than the Hindoos or the Chinese. Mr. Unwin came to reside at Penzance, and negociated for supplies of tin on behalf of the company, while Mr. Nicholas Donnithorne acted for the Associated Tinners. So much satisfaction did the tinners feel with the conduct of Mr. Unwin that they granted him a percentage on all the tin sold to the company. The company at first paid 68¾l. per ton, which price was augmented in 1792 to 71l., thus giving the East India Company an advantage of 19l. per ton, while the home price stood at 90l. per ton. This price was maintained till 1796, in consequence of the increased demand for tin in the European markets. In the latter year died Mr. Nicholas Donnithorne, whose great services to the tin trade are attested by the numerous resolutions in his favour recorded by the Associated Tinners.

When the Charter of the East India Company was renewed, a clause was inserted at the instance of the Members of Parliament (then 40 in number) representing the county and boroughs of Cornwall, whereby the company were bound to export to countries eastward of the Cape of Good Hope a considerable proportion of all the tin raised in Cornwall. Strange to say, about the same time that the export of tin was then enjoined, Lord Henry Petty, subsequently the celebrated Marquis of Lansdowne, who was so greatly distinguished during a large portion of his life as the advocate of Free Trade and everything that was Liberal, induced the Government, at the request of the consumers of copper, to prevent the export of Cornish copper to any port east of the Cape of Good Hope. The price paid by the East India Company continued at 75l. per ton until 1809, though the home prices had been steadily advancing, on account of the povery of the mines, and of the increased cost of labour and mining materials. In 1801 the home price was 94l.; in 1802, 100l.; and in 1806, 112l. There was a drop to 104l. in 1808l., but the price rose to 145l. in 1810, when the tinners refused any longer to sell tin to the East India Company at 75l. per ton, and, consequently, the company made no purchases that year. However, in 1811 the company advanced their price to 78l., and in 1812 to 80l., and made some purchases on those terms; but the system became more and more difficult to maintain, and after the year 1816 the export trade to India and China may be said to have ceased, as only two small sales of tin were subsequently made to the East India Company. During the years 1789-1816, which include the whole duration of the exportation, the quantity of tin produced in Cornwall was 80,000 tons, of which more than one-fourth was sold to the East India Company.

The Associated Tinners still retained a kindly rememberance of the services rendered to them by Mr. Unwin, and being informed of his death in 1820, and of the destitution in which he had left his family, they resolved at their quarterly meeting held at Truro on July 14 in that year, on the motion of Mr. William Reynolds, seconded by Mr. Thomas Trestrail, to contribute to the relief of the family 3s. per ton on all the tin coined during the next Michaelmas quarter.

During the twenty years, 1818-1837, the price of tin fluctuated considerably. In 1818 it was 84l., but dropped to 73l. in 1820; in 1823 it had risen again to 94l., but from 1826 to 1834 the average price was 77l. per ton. There was a great rise in 1835 to 91l., and the increase continued, till in 1836 it was as high as 126l., after which there was an immense drop to 88l. per ton. At this time the annual importation of Banca tin to Holland was 2700 tons, and the Straits tin—that is tin from both sides of the Straits of Malacca—imported to England amounted to 1300 tons. During the ten years ending 1834 the average production of tin in Cornwall was 4500 tons, worth from 65l. to 80l. per ton. Up to 1838 a seignorage duty of 4l. per ton had been paid to the Duchy of Cornwall, which had always been felt as a great burden. In that year this duty was taken off, and the Duchy was recompensed for the loss with 16,000l. a-year out of the Consolidated Fund. Not long after the high duty, almost amounting to prohibition, on the importation of foreign tin was reduced, and subsequently entirely abolished.

Between the years 1838 and 1846 the production of tin was considerably augmented, and four times during this period it rose to 6000 tons. In 1836 the price rose as high as 126l. per ton, but during the succeeding four years declined to 81l., and in 1842 to 67l. In 1843 the lowest price known in the present century was reached—60l. per ton of metallic tin. It may give some consolation to those who have been desparing of the future existence of Cornish mines to know that in the period under consideration the price paid for tin ore to one of the mines in the Land's End district fell within one year from 90l. to 47l. per ton, and yet this mine managed, in spite of such a fearfully low price, to carry on its working, and to rise again into considerable prosperity. In 1845 the price of tin rose to 106l., but in 1850 had settled down to 82l. In the succeeding years a continued rise was experienced, and the highest point was reached in 1857, when the price reached 146l. The supply of Cornish tin during this period had remained almost stationary, 6177 tons having been produced in 1856. Since that date it has largely increased, and during the year 1865 nearly 10,000 tons of tin were raised. This increase has taken place throughout the county, but especially in the Camborne district, and is mainly owing to the fact that mines which had yielded much tin ore near the surface, but had afforded copper at greater depths, became a second time rich in tin as they were sunk still deeper, and in some degree to improved machinery for stamping and dressing ores which has been introduced during the last few years. It is well known that in mining districts there are thousands of tons of rubbish thrown out around mines which contain a portion of tin, but which could not when thrown out be profitably dressed. From this rubbish, by the aid of new mechanical appliances, a sufficient percentage of ore has been extracted to leave a small profit after being stamped and dressed. It is believed that no inconsiderable quantity of the tin now produced in Cornwall is got from stuff which 20 years ago would have been thrown away as unprofitable.

In 1799 there existed in Cornwall 60 copper mines, half of which had not then begun to raise ores. It is estimated that the number of men, women, and children employed in these mines was about 7000. An old return of the state of copper mines shows that in 1798 North Downs produced more ore than any other mine, having raised no less than 52,000l. worth. The next on the list, in the order of importance, are Wheal Unity, the United Mines, the Consolidated Mines, Tincroft, Herland, Wheal Fortune, Wheal Treasury, Crenver and Oatfield, Wheal Jewel, and Cook's Kitchen. It will be observed that Tincroft, Wheal Fortune, and Cook's Kitchen, then worked as profitable copper mines, have since that period totally changed their character, being now almost solely tin mines. The column which shows the profit made by these mines considerably changes their relative position, as North Downs, though it produces most ore, only profited by this superiority to the extent of 147l. Wheal Unity made a profit of 17,000l. Tincroft follows with 14,000l., and Wheal Fortune with 8750l. The profits of the remainder were under 4000l. The greatest loss on any mine was nearly 13,000l., which had to be borne by the unfortunate adventurers of Pedn-an-drea. From the year 1798 to 1804 the produce of Cornish mines continued pretty steady at about 5500 tons per annum. Before this time the mineral characteristics of the south-western part of Devonshire around Tavistock had begun to attract the attention of mining agents; a few copper mines had been started which at the beginning of the present century produced about 300 tons of fine copper per annum. The price of the metal gradually increased from 124l. per ton in 1799 to 180l. per ton in 1805, when, owing to the flourishing state of the export trade, the adventurers in copper mines put forth all their exertions, and for some years the quantity produced was about 7000 tons of fine copper per annum. In 1811 Wheal Alfred produced the largest quantity of copper ore, the next in order being Dolcoath, now so celebrated as a tin mine; next came Wheal Unity, Wheal Abraham, Poldice, and Wheal Daniel. In 1818 the price of copper stood at 121l., which was increased to 136l. in 1819. After this there was a great drop to 104l. in 1822. The quantity of fine copper produced that year was 9331 tons, and in 1827 it rose to 10,450 tons, the price being in the latter year 106l. The supply for the next dozen years varied from 11,000 to 12,000 tons; but in 1841 it fell again to 9900 tons, and the price went up to 119l. During the next two years the supply of copper came up to the former level, and the price was reduced, first to 110l. and then to 104l. In 1852 the quantity of copper ore was 165,593 tons, containing 11,776 tons of copper, of the value of 975,975l. During 1857, 13,000 tons of copper were raised in Cornwall, including the Tavistock district; but the supply had declined to 11,500 tons in 1862, and to 9750 tons in 1865; the value in the latter year being 757,000l. The mean average price per ton in 1865 was 94l. 7s.; the lowest price in the year was 89l.; the highest was reached in December last, and was 109l.

The lead mines of Cornwall are very ancient. Some near Helston have been wrought above 300 years. In 1828 the quantity produced was 2000 tons; in 1838, 1800 tons. In 1856 the number of mines in Cornwall producing lead was 42, of which 19 only produced any considerable quantity. East Wheal Rose produced 1770 tons of pure lead; Wheal Mary Ann, 849 tons; Wheal Wrey Consols, 760 tons; and Wheal Trelawny, 761 tons: the total quantity was 6597 tons, out of 9973 tons of ore. In 1865 the produce had very considerably fallen off, as only 19 mines produced lead, and the total quantity of lead raised was 4296 tons, of which West Chiverton raised 1797 tons; Cargoll, 675 tons; and Wheal Trelawny, 532 tons. In 1852 the average amount of silver in Cornwall to the ton of lead was 35 ozs. In 1856 the total quantity of silver was 248,000 ozs.; Wheal Mary Ann and Wheal Trehane had about 60 ozs. of silver to the ton; and East Wheal Rose half that quantity; while Wheal Langford, out of 10 tons of lead, extracted 1660 ozs. of silver, or 166 ozs. to the ton; and in South Garris the proportion was 96½ ozs. to the ton. In 1865, 214,000 ozs. of silver were produced, of which West Chiverton had 73,000 ozs., or 41 ozs. to the ton. Herodsfoot had the highest proportion—87 ozs. to the ton.

The iron mining of Cornwall is of comparatively recent date. In 1837 the estimated production of iron ore in the county was 30,000 tons. In 1856 about 122,000 tons were actually raised; and in 1865 the quantity had increased to 360,000 tons, of the value of 10,600l. The chief mines are Restormel, Pawton and Tremoor, Knighton and Ruby, and Trebisken.

A short summary of statistics for the year 1836 may, perhaps, not be unprofitable. In that year the Consolidated Mines sold copper ore to the amount of 110,000l.; Fowey Consols and Tresavean each about 86,000l.; Carn Brea, 53,000l.; Wheal Jewel, 45,000l.; Levant, 36,000l.; and East Wheal Crofty, 32,000l. Next below these stand Great St. George, North Roskear, United Hills, West Unity Wood, and Dolcoath, all above 20,000l. In the year the tin ore of the Charlestown United Mines brought 36,000l.; Wheal Vor, 31,000l.; Wheal Kitty, 19,000l.; St. Ives Consols and Polgooth, each 18,000l.; Great Work Consols, 13,000l.; and Boscaswell Downs, 10,500l. Next in order are Wheals Reeth, Darlington, Mary, and Budnick, Bottle Hill, Balnoon, and Carnon, ranging between 10,000l. and 7000l. The total number of Cornish mines selling copper ore in 1836 was 99; the ores they produced fetched 976,650l.; and the average value of the ore was 7l. 4s. per ton. Among the larger copper mines the ores of Levant obtained the highest average price—15l. 10s. per ton. The number of mines selling tin ore was 59, and the ores they sold realised 267,000l. The ores of Great Work Consols fetched 75l. per ton, being 10l. per ton higher than the average of the other large mines. The only mines which figured considerably both as copper and tin producers were the Marazion mines, with copper 15,000l., and tin 5800l.; and Levant, with copper 36,000l., and tin 3200l.

From a return appended to Mr. Henwood's "Metalliferous Deposits of Devon and Cornwall," we are able to give some idea of the number of persons formerly employed. In the year ending June, 1838, the following mines employed more than 500 persons:—In the St. Just district, Balleswidden, 634; Levant, 550; in the Helston district, Wheal Vor, 1174, of which 391 were men, 327 women, and 255 children; in the Camborne district, East Wheal Crofty, 1004, made up of 456 men, 404 women, and 144 children; Carn Brea, 723; North Roskear, 640; Dolcoath, 590; in the Redruth district, Consolidated and United Mines, 1730 men, 869 women, 597 children: total, 3196; Tresavean, 1354; in the St. Austell district, Fowey Consols, 1680. The total number employed in the year was about 30,000, of which 18,500 were men, and the remainder equally divided between women and children. The average wages of men during the year were about 2l. 12s. 6d. per month, and of women and children 14s. 6d., which gives us a total of 682,000l. for wages alone.

Two years ago tin mining in Cornwall was in a flourishing condition. Adventurers were making a fair profit, working men of almost every grade were getting good wages, and some who had children working in or about the mines were earning what, in these cheap-living districts, is considered a sufficiency, and something to lay by for a rainy day. For several years prices had been high, and occasionally very high; the consequence was, that besides those few extraordinary mines that have been working for so many years, producing first tin, then copper, and then tin again, a large number of new mines had sprung up, and old mines had begun to be re-worked. These employed a greater number of hands than had ever been engaged in this occupation before, and without doubt at better wages. This large increase of mines, calling forth the activities of so many persons, necessarily forced on the market large supplies of metal—the simple result of opening up so many mines, and of the application of so much labour. These inevitable consequences reached their climax about Christmas last, and in January the commercial effects began to be felt. It may be stated, without fear of contradiction, that the last eight months have been the most trying period both for adventurers and working miners that has occurred for nearly twenty years. In 1864, 15,200 tons of tin ore had been raised. This was followed in 1865 by the raising of 15,686 tons, containing 10,400 tons of metallic tin, as it will be borne in mind that 3 tons of tin ore produce about 2 tons of metal. Of late Cornwall has produced on an average about 1300 tons of tin ore per month. During the first eight months of the present year 10,127 tons of tin ore were sold, besides which about 350 tons were withheld from the market in St. Just and elsewhere in hope of better prices.

The price of tin (metal) throughout December, 1865, stood at 102l. per ton. This price was maintained until the end of January, when a fall of 5l. per ton took place, and early in February a further decline of 2l. per ton. In April came the great monetary crisis, and prices continued to decline until July 1, when tin (metal) was quoted at 82l. per ton, thus exhibiting from Jan. 1 to July 1 a fall of 20l. per ton, being an average decrease in price of nearly 1l. per ton per week. From this statement it will be plain that during the first six months of this year the average price of tin ore declined 13l. per ton, which is equal to a fall of 20l. per ton of tin (metal). In July last the price was 48l. 15s. per ton of best tin ore, but the rise of 7s. in the standard during the past fortnight, which is equal to about 4l. per ton of tin ore, has raised best tin ore to 52l., and common ore to an average of about 48l. 10s., or 49l. per ton. In the same month the price of Straits tin was 74l., but it gradually crept up to 84l. Within the last few days—that is to say, since the rise of the market, Straits tin has receded to 81l. per ton. This fall is in consequence of some speculators being anxious to realise their profits. It will be remembered that at the beginning of the year this description of tin stood at about 96l. per ton, so that there has been a total decline up to July of 22l. per ton, and up to the present time of 15l. per ton.

Taking the St. Just district as a sample of many other centres of mining in the county, we present a few interesting facts connected with it. In Sept., 1865, nine of the St. Just mines raised 260 tons of copper and 335½ tons of tin. The produce of this quantity was 21,112l., but notwithstanding such returns, and in spite of the most careful and searching economy, these mines incurred a loss of 1115l. The price of the best tin ore raised there was 58l. 10s. per ton, or 2l. 10s. more than during the American war. In the month of April, 1866, a great emigration of miners from the St. Just district took place, and a very large number of men left to seek work in America and Australia. The continued fall in the tin standard had by the end of April lessened the already fearfully low prices for tin ore, which then sold from St. Just for 50l. up to 51l. 10s. per ton, or 16l. less than the average price during the last 15 years, and 40l. below the highest price that has been attained. Since that time the St. Just United Mines and Spearn Consols have stopped working.

A short statement of the fluctuations in quantity and price of Banca tin during the last few years should here be given. In the year 1853 about 3700 tons were sold; by 1857 the annual quantity sold had increased 54 per cent., and in that year 190,559 slabs were sold, equal to about 5700 English tons. Yet, strange to say, although this was a larger quantity than had ever up to that time been sold, the price was enormously high, being 140l. 10s. per ton, or 15l. higher than in the preceding year. The quantity sold in the next year was nearly the same, but the price declined to 116l. In 1859 the sale decreased in amount by more than 1200 tons, and, consequently, the price was the highest ever known in later years—141l. per ton. The quantities sold in the next few years were from 149,000 to 155,000 slabs, but the price receded to 115l. 10s. A reduction of supply by more than 1000 tons in 1863 sent up the price to 130l., but since that time the sum realised has steadily decreased, in the face of the ever-increasing supply. At the annual sale in 1865, 167,800 slabs, or about 5000 tons, were sold at 97l. 10s. per ton.

The arrivals of Banca tin from Batavia into Holland from Jan. 1 to Dec. 31, 1865, were 183,070 slabs, equal to 6039 tons. The months in which the largest quantities usually arrive are July and August, but during the first four months of the present year the deliveries in Holland largely increased, as compared with those of the same months in the four previous years, being 61,347 slabs, or 1850 tons, in the four months of 1866, and 24,517 slabs in the corresponding months of 1865. This year the Dutch Trading Company resolved to hold two half-yearly sales in each year, instead of one annual sale. The first of these half-yearly sales was held on March 22 last, when 111,800 slabs, or about 3400 tons, of tin were sold. This was a larger quantity than was anticipated by 11,800 slabs. The amount produced by the sale was 87*l.* 10s. per ton, a less price than any previous sale during the last fourteen years had realised. The next sale will be held on Sept. 28, and 110,000 slabs of Banca tin are then to be sold, being 20,000 slabs less than was anticipated. The total stock of foreign tin in England and on the way to England is just over 4000 tons, against 4800 tons at the corresponding period of 1865. The stock of Banca tin in Holland at the present time is 6500 tons, against 5800 tons last year. The stock of tin in America, and on the way to America, is estimated at from 900 to 1000 tons. The stock of English tin is not greatly in excess of what it has usually been during the last few years.

NEW BURNING FLUID.—Prof. A. DEMBINSKY, of Old Ford-road, Bow, proposed to mix oil, 24 parts; nitrate of potash, 2 parts; sal ammoniac, 1 part; and magnesia, 1 part, and states that in burning this composition produces no smoke or smell, is inexplosive, cheap, and in burning leaves a residium which may be used for fireworks.

PULVERISING ORES.—The invention of Mr. JAMES JONES, of San Francisco, and 8, Southampton-buildings, is an improvement upon Blake's stone-crusher, already well known to the readers of the *Mining Journal*. Both jaws are moveable, and each is worked direct from the eccentric on the fly-wheel shaft by horizontal connecting rods. Whether the original or the improvement is entitled to the merit of having the balance of advantages in its favour is questionable.

JAPANESE ALLOYS.

The following notes relating to the composition of some of the many alloys in use among the Japanese are based on information obtained from native metal-workers. In a few instances, as with the *shakdo* and *gin shi bu ichi*, the process of manufacture, generally hidden, was shown me.

1.—*Shakdo*, an interesting alloy of copper and gold, the latter metal in proportions varying between 1 per cent. and 10 per cent. Objects made from this composition, after being polished, are boiled in a solution of sulphate of copper, alum, and verdigris, by which they receive a beautiful bluish-black colour. I can explain this colour only by supposing that the superficial removal of the copper exposes a thin film of gold, and that the blue colour produced is in some manner due to the action of light on this film of gold. The intensity of the colour and, to a certain extent, the colour itself are proportionate to the amount of gold, 1 or 2 per cent. of this metal producing only a rich bronze colour. Pure copper treated in the above solution received the appearance of an enamelled surface with a rich reddish tint, and brass a similar surface with a darker shade. *Shakdo* is used for a great variety of ornaments, such as sword-guards, pipes, clasps, &c.

2.—*Gin shi bu ichi* ("quarter silver") is an alloy of copper and silver, in which the amount of silver varies between 30 and 50 per cent. Ornamental objects made from this composition take, when subjected to the action of the above solution, a rich grey colour, much liked by the Japanese. It is used for sword ornaments, pipes, and a great variety of objects.

3.—*Mokume;* several alloys and metals of different colours associated in such a manner as to produce an ornamental effect. Beautiful damask work is produced by soldering together, one over the other, in alternate order, 30 or 40 sheets of gold, *shakdo*, silver, rose copper, and *gin shi bu ichi*, and then cutting deep into the thick plate thus formed with conical reamers, to produce concentric circles, and making troughs of triangular section to produce parallel, straight, or contorted lines. The plate is then hammered out till the holes disappear, manufactured into the desired shape, scoured with ashes, polished, and boiled in the solution already mentioned. The boiling brings out the colours of the *shakdo, gin shi bu ichi*, and rose copper.

4.—*Sin chu* (brasses).—The finest quality of brass is formed of 10 parts of copper and 5 of zinc. A lower quality, of 10 parts copper and 2·7 zinc.

5.—*Kara kane* (bell-metal).—First quality, copper 10; tin, 4; iron, ½; zinc, 1½. Second quality—Copper, 10; tin, 2½; lead, 1⅓; zinc, ½. Third quality—Copper, 10; tin, 3; lead, 2; iron, ½; zinc, 1. Fourth quality—Copper, 10; tin, 2; lead, 2. In forming the bell-metals the copper is first melted, and the other metals added in the order given above. The best small bells are made from the first quality. Large bells are generally made from the third quality. The *kara kane* has a wide range of use in Japan.

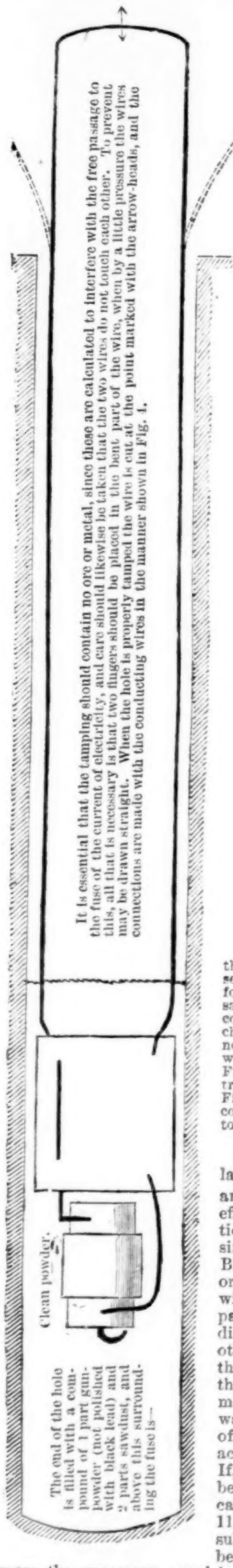
Solders.—For bell-metal—Brass, 20; copper, 10; tin, 15. For brass—First quality brass, 10; copper, 1½; zinc, 6. For silver—Silver, 10; first quality brass, 5 or 3. For *gin shi bu ichi*—Silver, 10; first quality brass, 5; zinc, 3. For *mokume*—Silver, 10; first quality brass, 1½. For *shakdo*—Fine *shakdo*, 3; zinc, 10. For tin—Tin, 10; lead, 5.

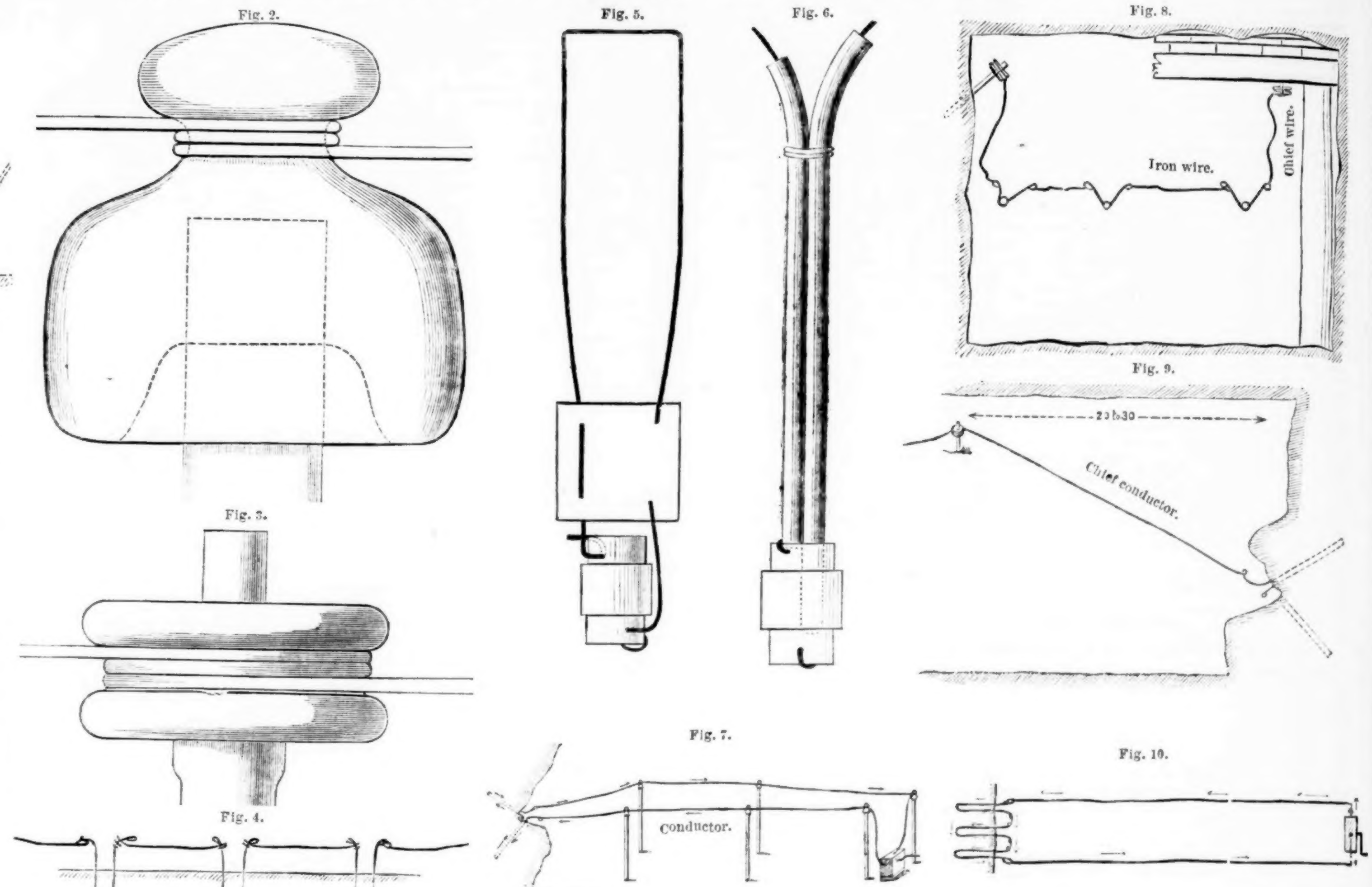
Among the Japanese articles made of copper that find their way to this country there are some with a bright red surface, which is often taken to be either a acquer or an enamel. These articles are made of copper containing red oxide through the entire mass, and, after receiving the requisite form and a high polish, are boiled in the mixture mentioned above.—RAPHAEL PUMPELLY *Silliman's American Journal of Science and Arts.*

RENDERING PUDDLING AND HEATING FURNACES MORE DURABLE.—In order to avoid the necessity for frequent repairs required in puddling furnaces and heating furnaces used in the manufacture of iron and steel, Mr. W. JEFFRIES, of West Bromwich, proposes to support the bed of the furnace on arches running from end to end of the bed, and through which the air freely circulates. The bed of the furnaces is provided with passages, and the air circulating through these, the bed of the furnace is kept cool.

IMPROVEMENTS IN BORING AND BLASTING.

Fig. 1.





In the annexed diagrams Fig. 1 represents the hole, full size, with charge and fuse inserted ready for blasting; Fig. 2, the insulator for surface-work, vertical section; Fig. 3, the same for underground-work; Fig. 4, mode of connecting several holes to be fired by one discharge of electricity; Fig. 5, ordinary fuse for non-metalliferous ground; Fig. 6, the same with covered wire for metal-bearing ground; Fig. 7, mode of blasting on surface; Fig. 8, transverse section of end ready for blasting; Fig. 9, longitudinal section of same; Fig. 10, connections of electrical machine and holes to be fired.

In all contrivances for lessening the labour of the working miner simplicity and cheapness are quite as necessary as efficiency, and if all these recommendations be combined little more can be desired. Messrs. Richards and Abegg, of Bishopsgate-street, are introducing an ordinary ratchet brace, 30 inches long, with a spiked end or foot to keep the apparatus in position. The machine, a diagram of which will be found in another column, being placed in position, the borer is screwed against the rock, and the boring is then effected by the ratchet movement screwing the boring-bit forward. A brake is provided, the friction of which will stop the nut of the screw, according to the hardness of the stone. If, therefore, the pressure on the borer be too strong, the friction of the brake can be reduced. The borer is driven out 11 inches, and then a new borer must be substituted. The machine must always be well oiled in all its parts, for which purpose the necessary provision is made. The two cuts of the bit of the borer are not even; the diameter of the hole becomes thereby a little larger than the bit, which prevents the sticking of the borer. For clay-slate, limestone, gypsum, and other stones which do not grind, the bits of all the borers are of the same size. For grinding stones the bits of the short borers are a little larger. The borers must be turned to and fro with the key for extricating them from the horizontal holes. There is a side hole at the head of the machine for stopping it with the key if the screw should have been driven out too tight to the end. The hole of the head where the borers are fixed must always be clean, and the borers must be well fitted, so that they can be taken out very easily. The different lengths of the borers are—1 ft. 6 in., 2 ft. 4½ in., 3 ft. 3 in., 4 ft. 1¼ in., and 5 feet. For boring soft stone two sets of borers are necessary, and one man can bore 4 to 5 feet in an hour; for hard stone, five to eight sets are required, and one man can bore 2 to 3 ft. in an hour. The stems of the borers are of iron; the bits of the best cast-steel, 5 in. in length, and case hardened. For hard stone the bit is not so large as for soft stone, as there is not so much space required for the escape of sludge.

For boring hard quartz the pressure on the bit must be increased to 3000 or 4000 lbs. on the inch, consequently the diameter of the borer-stem must be at least 1 inch if steel, or 1¼ inch if iron; and, as there must also be space allowed in the hole for the escape of sludge, the diameter of the bit must not be less than 1⅞ or 2 in. In quartz and hard granite one man can, in two hours, bore 1 ft. of such 2-inch hole (which has four times the contents of a 1-inch hole), and in that time from 10 to 15 bits will be blunted. The machine, therefore, can only be profitably used in these hard rocks when there is space enough to allow the force of the blast to do the full amount of work of which it is capable: in a small end of only 4 ft. to 6 ft. the machine will be inapplicable if the quartz veins are thicker than 2 in.; but for rock which is not extremely hard, such as hard limestone, clay-slate, gypsum, or hard sandstone, where the boring can be made at the rate of from 4 ft. to 6 ft. per hour, the machine can be used with the greatest profit, even in the smallest end.

The electric machine introduced by the same gentlemen is contained in a box of 10 in. square and 5 in. in thickness. Electricity is produced by the friction of a prepared India rubber disc on eight cats' skins. The condenser consists of particularly prepared India rubber plates, and has 12 square feet of acting surface. It is only by the use of such an enormous condenser that the electric machine could be introduced for blasting in mines, as it is impossible to have the chief conducting wires insulated underground. Damp is condensed on every substance, and the electric spark is, therefore, very much dispersed on its way to the holes. By the use of the large condenser electricity is produced in great quantity of little density, and the loss by damp and water is not so important as it would be with the common electric machine. Every substance which has usually been considered semi-conductors may be regarded as an insulator, but the black lead, with which the powder is very often polished, and the ore are to be cared for. The fuses consist of a piece of thick paper, on which two small brass wires are fixed in such a way that their points are close together; these points are covered with a powder, which is ignited by an almost imperceptible electric spark. The great thing is that the strongest blow would not explode such a fuse. The electric machine explodes such a fuse with uncovered wire even below the water. In blasting with this apparatus uncovered galvanised iron wire is used for the two chief conducting wires, which conduct the spark from the machine to the holes; this wire is fixed at the walls of the level, or on the top of the wooden sticks, as described in the subjoined engraving. The wire must not touch any other object but the wooden rollers. If there be no ore in the rock these wires may lay on the rock in the vicinity of the holes; if there be ore, they must be suspended for their whole length, and the covered wires of the fuses must be 5 in. outside the hole, in such a way that the uncovered chief conducting wires can be connected with them without touching the ore. When the holes are charged and tamped, as directed, the holes which are to be blasted together must be thus connected by small uncovered iron wire, as shown in Fig. 4.

The right hand wire of the hole which is nearest to the left is connected with the left hand wire of the next hole, and so on. Then the left side chief conducting wire is connected with the left hand wire of the hole which is the nearest to the left, and the right hand chief conducting wire with the right hand wire of the hole which is the nearest to the right. The other ends of the chief conducting wires are connected with the rings of the electric machine, and the handle is turned till the holes explode, which will be with 20 or 30 revolutions.

The electric spark leaves the machine at one ring, goes in one of the chief conducting wires to the holes, passes through the fuses, and returns in the other chief conducting wire to the machine. If there should be any interruption in the wires the spark could not proceed any further. If there was a communication between the wires by ore or metal the spark would go there from one wire to the other, and would, therefore, not reach the holes, and the fuses would not be ignited. Mr. Abegg claims that the advantage of the use of the electric blasting machine is, that when safety fuse is used there is a hole leading from the powder through the tamping to the outside at the moment when the explosion occurs, the safety fuse which filled the hole before being burnt. Calculation shows that the pressure of 200 atmospheres, which is produced by the explosion of the powder, is diminished to 150 atmosphere after 1-100 second by the escape of the gas through the hole of the burnt safety fuse.

Hard stone tears after 1-60 second, soft stone after 1-30 to 1-20 second; it is thereby proved that the tearing power is at least three times stronger by the use of the electric instead of the safety fuse. The price of the covered wire, which is necessary for blasting in ore, is the same as the price of the safety. One electric fuse costs 0¼d. The increase of the expense of 0¼d is more than ten times compensated by the increased effect of tearing, and the saving of the blasting powder; that if the holes are placed in one straight line, thus— . . . . their effect of tearing is considerably increased by the simultaneous explosion; that the smoke is diminished; and that if a fuse should become injured and damp, or if the wires of the fuse (when uncovered wires are used) should come in contact inside the hole by the tamping, or if a piece of ore should be amongst the tamping, and should produce a conducting connection between the two wires inside the hole, by shaving their covering the hole would not explode, but as there was no possibility of explosion the hole may be scraped out immediately without any danger; the miner will, however, easily avoid any cause for the misfiring of a hole, so that inconvenience in this need never occur. At Devon Great Consols the machine, after having been a fortnight in the 60 fm. level, was tested for blasting purposes, and Mr. James Richards, the manager, has certified that it answered exceedingly well.

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